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GENERAL NOTES.

Second Catalogue of Variable Stars.—In 1903 a provisional catalogue of variable stars was published by Harvard College Observatory as No. 3 of Volume XLVIII of the Annals of that institution. During 1907 a second catalogue (the word "provisional" is omitted) was published as Part I of Volume LV. Both catalogues were compiled by Miss ANNIE J. CANNON, assistant in the observatory, under the supervision of Director PICKERING.

The provisional catalogue contained 713 stars, while the one just issued contains 1,447 stars, which, however, does not include 514 variables in globular clusters, and 1,791 very faint variables in the Magellanic Clouds, found by photographic methods. If these be added to the total of the catalogue, the grand total is 3,748, 2,909 of which were discovered at the Harvard College observatories.

The number of known variable stars has grown wonderfully during the last half century. The first catalogue published was by ARGELANDER, in 1844, and it contained reference to eighteen variables. SCHÖNFELD'S first catalogue, 1865, contains 113 stars; CHANDLER'S first catalogue, 1888, 225 stars; CHANDLER'S third catalogue, 1896, 393 stars; Harvard provisional catalogue, 1903, 783 stars; Harvard second catalogue, 1907, 1,447 stars.

The observation of variable stars has lagged far behind discovery, and a glance at this new catalogue shows how deficient our knowledge of many of these interesting objects is. The catalogue gives the classification of the variables according to the plan suggested by Professor PICKERING in 1880. Of the first class (new stars) there are now 20; of the second class (long-period variables), 434; of the third class (irregular variables), 134; of the fourth class (short-period variables of continuous variation), 77; of the fifth class (*Algol* type variables), 47; of class unknown, 735. It is thus seen that the class of over half the variables listed is unknown. Many of these are the faint variables recently discovered by Professor WOLF and the Harvard observers in nebulous regions.

S. D. T.

Allegheny Observatory.—Number 1 of Volume I, *Publications of the Allegheny Observatory,* has recently appeared. It is a six-page contribution on the distortion of photographic films, by Dr. FRANK SCHLESINGER, director of the observatory. In this investigation Dr. SCHLESINGER used methods which differ materially from those employed by previous investigators. A Cramer instantaneous isochromatic plate was exposed to the region about 61 *Cygni,* and then developed, fixed, washed, and dried by the ordinary process. The positions of fifty-nine stars were determined by means of a measuring engine, and then the plate was again subjected to a process of developing, fixing, washing, and drying, and again measured under circumstances as nearly as possible identical with those used in the first instance. The distortions found in this way were all small, much smaller than the errors of bisection for good star images.

The plate was then subjected to nine excursions through the processes of development and drying, and measured for the third time, but the magnitude of the distortions was not increased. A number of variations in the experiments were introduced, but the resulting distortions were in all cases small.

Some Astronomical Consequences of the Pressure of Light.—Regarding a beam of light as a momentum-carrier, it is easily seen that if the receiving surface has velocity u towards the source and the velocity of light is U, the pressure is increased by the motion by the fraction u/U. If the velocity is reversed, the pressure is decreased by this fraction. This is the "Doppler reception effect."

If the source is moving, and we assume that the amplitude of the emitted waves depends on the temperature and nature of the source alone, it can be shown that the pressure on the source is $\mathrm{U}/(\mathrm{U} \mp u)$ of its value when the source is at rest. This is the "Doppler emission effect."

In considering the consequences of light-pressure, it is necessary to know the temperature of a body exposed to the Sun's radiation. It can be shown that a small black particle, at the distance of the Earth from the Sun, has about the mean temperature of the Earth's surface,—say, 300° Abs.,—and that the temperature of the Sun is about twenty times as high,—

say, 6,000° Abs. The temperature of the particle varies inversely as the square root of its distance from the Sun.

The direct pressure of sunlight is virtually a lessening of the Sun's gravitation-pull. On bodies of large size this is negligible. On the Earth it is only about a forty-billionth of the Sun's pull; but the ratio increases as the diameter decreases, and a particle one forty-billionth of the Earth's diameter, and of the same density, would be pushed back as much as it is pulled in, if the law held good down to such a size. If the radiating body is diminished, the ratio of gravitation-pull to light-push is similarly diminished; and it can be shown that two bodies of the temperature of the Earth's surface and the Earth's mean density would neither attract nor repel each other, if their diameter was about one inch. The consequence of this on a swarm of meteorites is obvious. It is probable that this balancing of gravitation and light-pressure must be taken into account in the motion of the particles supposed to constitute *Saturn's* rings.

When we consider the motion of a small particle round the Sun, we have, first, the direct pressure lessening gravitation. If it has density equal to that of the Earth and diameter one thousandth of an inch, the lessened pull at the distance of the Earth will imply a lengthening of the year by nearly two days. Secondly, the Doppler emission effect comes into play; for the particle crowds forward on its own waves emitted in front, and draws away from those emitted behind, so that there is increase of pressure in front and a decrease behind. Thus there is a force resisting the motion. The particle will then tend to fall inwards in its orbit, and, in the case considered, about 800 miles in the first year. It would probably move in a spiral into the Sun, and reach it in less than one hundred thousand years. A particle one inch in diameter would reach the Sun from the Earth in less than one hundred million years.

The Doppler reception effect will not come into play in a circular orbit, but in an elliptic orbit it acts as if it were a force resisting change of distance, and therefore it tends to make an elliptic orbit even more circular.

Applying these considerations to a comet regarded as a swarm of small particles coming into our system, a sorting action will at once begin. The smaller particles will have their period of revolution lengthened out more than the larger ones, and they will tend to trail behind. The Doppler emission effect will damp down the motion, and again more markedly with the smaller particles, and all will tend to spiral into the Sun. The Doppler reception effect will tend to destroy the ellipticity of the orbit, more especially with the smaller particles, and ultimately the particles of different sizes may move in orbits so different that they may not appear to belong to the same system. In course of time they should all end in the Sun. Perhaps the zodiacal light is due to the dust of long-dead comets.

It appears just possible that *Saturn's* rings may be cometary matter which the planet has captured, and on which these actions have been at play for so long that the orbits have become circular.—*Extract from an article by* J. H. POYNTING, *in Popular Astronomy for December.*

Periodic Comets Due in 1908.—Comet Giacobini, 1900 III, period about seven years, and Comet Denning, 1881 V, period about 8.8 years, are expected early in the year. ENCKE'S comet, first seen in 1786 by MÉCHAIN, and observed at every return since 1818, when its period was found by ENCKE to be about 3.3 years, is due to return to perihelion at the end of April. Comet 1869 III, of period about 5.5 years, discovered by TEMPLE, and found to be periodic after SWIFT rediscovered it in 1880, has been observed since only at the apparition of 1891; it is expected in the summer.

Notes on the Transit of Mercury, 1907, November 14th, from Continental Observations.—Observed times of contact seem to have been about a minute earlier than computed times. The black ligament was conspicuous. The planet appeared very black. Little evidence was obtained of the presence of its rare atmosphere.

Meteorites.—The *Journal B. A. A.*, Volume XVIII, No. 2, gives notes from an abstract in *Nature,* by L. J. S., of "Some

Recent Papers on Meteorites." Dr. H. A. WARD, in *Proceedings of the Rochester Academy of Science,* Volume IV, pages 137-148, 1904, describes the Willamette meteorite, found in 1902 near Willamette, Oregon. The mass of metallic iron measures 10 x 6½ x 4¼ feet, and weighs about 15½ tons, being the third largest meteorite known. The two heavier ones are the Anighito, of 36½ tons, brought by PEARY from Greenland, and the Bacubirito (Mexico), with an estimated weight of 27½ tons. The Willamette meteorite is conical in form, and was found embedded in the ground, base uppermost. It is probable that in consequence of weathering none of the original surface remains. Analysis shows 91.5 per cent of iron, 8 per cent of nickel, and small amounts of cobalt and phosphorous. Professor O. C. FARRINGTON, in *Field Columbian Museum Geol. Ser.,* Vol. III, pp. 57-110, 1907, collects 360 published analyses of 248 meteoric irons. The average composition is: Iron, 90; nickel, 9; cobalt, 0.9; copper, 0.02 per cent.

Notes from "Science."—The Lalande prize of the Paris Academy has been awarded to Mr. THOMAS LEWIS, of the Royal Observatory, Greenwich, and secretary of the Royal Astronomical Society. *The Observatory* states that during the last twenty years there have been twenty-one recipients of this prize, of whom nine were American, nine French, one South American, one Italian, and (the present award) one Englishman.

Dr. WALTER M. MITCHELL has been appointed director of the Haverford College Observatory.

PIERRE CHARLES CESAR JANSSEN, director of the Meudon Astrophysical Observatory, died on December 23d, at the age of eighty-three years.

M. GONNESSIAT, of the Paris Observatory, has been appointed director of the Observatory of Algiers.

Dr. E. O. LOVETT, professor of mathematics at Princeton University from 1900 to 1905, and since professor of astronomy, has resigned to accept the presidency of the institute established at Houston, Texas, by the late WILLIAM M. RICE, with an endowment, which, after long litigation, is said still to amount to over two million dollars.

M. Bourget, of the Toulouse Observatory, has been appointed director of the Marseilles Observatory, to succeed M. Stephen, who has retired.

M. M. Nyrén, of the Pulkova Observatory, retired from his office at the end of 1907.

Charles A. Young.—On January 3d America lost another of her eminent astronomers through the death of Professor C. A. Young, at Hanover, N. H., to which place he retired after becoming professor *emeritus* of astronomy at Princeton University in 1905. An appreciative article on the life and work of Professor Young was published by Director E. B. Frost, in *Science* for January 24th, and it was from this article that most of the information given below was obtained.

"Charles Augustus Young was born on December 15, 1834, at Hanover, where his grandfather and father successively occupied the chair of natural philosophy in Dartmouth College during the period from 1810 to 1858. He entered college early, and graduated with distinction in 1853 as bachelor of arts. During his student days he assisted his father in astronomical observations, and accompanied him in 1853 on a trip to Europe to purchase instruments for the Shattuck Observatory, then in the course of erection. For two years after graduation he taught classics at Philips Academy, pursuing at the same time theological studies at the Andover Seminary. In 1857 he went to Hudson, Ohio, as professor of mathematics and natural philosophy at Western Reserve. During several summer vacations he assisted in the governmental survey of the Great Lakes. Responding to the call of patriotism in 1862, he was for four months captain of Company B in the Eighty-fifth Regiment of Ohio Volunteers, which was largely recruited from students.

"In 1866 he returned to Dartmouth as professor of natural philosophy and astronomy, thus continuing the family tradition. . . . In 1877 he accepted a call to Princeton, where much larger instrumental facilities were offered to him, with less confining teaching duties. He gave, however, much time to the organization and equipment of the Students' Observatory, making it then probably the best in the country. A powerful spectroscope was provided for the 23-inch equatorial of the Halsted Observatory, and with this he made important observations of the chromosphere and sun-spots."

Professor YOUNG was especially interested in the physical side of astronomy, and was one of the pioneers in the use of the spectroscope, especially in its application to the study of the Sun. He observed the solar eclipse of 1869 at Burlington, Iowa, and demonstrated from his observations the gaseous nature of the corona; that of 1870, in Spain, when the flash spectrum was seen for the first time; that of 1878, at Denver; and that of 1900, in North Carolina. He also made a trip to Russia in 1887 to observe the eclipse of that year, but clouds intervened. In 1872 he spent the summer in Wyoming, at an altitude of 8,000 feet, for the purpose of measuring the wave lengths of lines of the solar spectrum, which could not be successfully observed at lower altitudes with the instrumental equipment then available. In 1874 he observed the transit of *Venus* at Peking. Professor YOUNG'S excellent book, "The Sun," first issued in 1881, and last revised in 1895, has been translated into several languages.

Professor YOUNG'S text-books, "General Astronomy," "Manual of Astronomy," "Elements of Astronomy," and "Lessons in Astronomy," constitute the most popular and successful series of text-books on astronomy ever issued, and have been used by over a hundred thousand students. Professor YOUNG was very successful as a teacher, and belonged to that class of men who are the most useful in the American university of to-day,—eminent investigators who are also successful teachers. S. D. T.

Head of Southern Observatory.—The superintendence of the work at the proposed Southern Observatory of the Carnegie Institution has been offered to Astronomer R. H. TUCKER, of the Lick Observatory, at present in acting charge of the latter, during the absence of the director.

The plan of observing is the design of LEWIS BOSS, director of the Dudley Observatory at Albany, who has been engaged for many years in the observation and reduction of a large and accurate fundamental catalogue of stars. The work of the Southern Observatory will include the stars that are too far south to be measured at the observatories of the northern hemisphere. It is expected that three years will be required for the plan, and the Southern station will be located either in New Zealand, South America, or South Africa. The party will probably consist of seven observers, several of whom have already been engaged.

The selection of one of the Lick Observatory staff for the prosecution of this work is one of the instances of the recognition of the standing of this institution in professional work that have not been uncommon of late. The requirements of this particular plan are mainly those of experience, technical skill, and persistence in the execution of a scheme of work. The work of a large observatory is very much specialized, just as professional work has developed in other lines.

It was as an observer, specially trained, that Mr. TUCKER was invited, fifteen years ago, to join the Lick Observatory force, and to take charge of the Meridian Circle and its work. Three quarto volumes have been since published, entirely devoted to the results of the observations made with this instrument during this period at the Lick Observatory. The work is of the character that has been fundamental in the development of our knowledge of the universe of stars and in tracing the motions of the planets of our complex solar system. The larger observatories in all parts of the world have always a force of astronomers working along this line. The smaller observatories rarely do any of this class of work.

This present expedition suggests, in a way, the early trip of Lieutenant GILLISS to Chile, to observe the Southern stars; and the much more extensive and successful scheme of Dr. B. A. GOULD, both of which eventually resulted in the foundation of national observatories at Santiago, Chile, and at Cordoba, Argentine Republic, respectively. There were earlier expeditions to the Cape of Good Hope, the first of LA CAILLE, and, later, one of HERSCHEL, which led to the establishment of the Royal Observatory at Capetown, now one of the finest in the world. The present scheme is expeditionary only, and the equipment will be brought back to this country when the specific work is completed.

The large Pistor and Martins Meridian Circle, of the Dudley Observatory, will be used for the Southern plan, and it introduces some feeling of sentiment, from the fact that the first professional observations of the astronomer, who is to take charge of this work, were made with that instrument.

Should San Luis, in the Argentine Republic, be finally selected as the observing station, there would be additional fitness in the working out of the scheme, since it was from the National Observatory at Cordoba, two hundred miles distant, that the observer came here, fresh from nine years' service under the Southern skies.

The Mills Expedition, of the Lick Observatory, is now located at Santiago, under the charge of Dr. H. D. CURTIS; and while the Cordillera of the Andes would lie between the two stations, making a barrier of no ordinary magnitude, the two stations might easily get into touch with each other, by exchange of compliments. The work of the two stations does not conflict in any way; the established one is for the physical investigation of Southern stars, by means of the spectroscope; the new one will confine its work to the measurement of the positions of the stars.—*San Jose Mercury, January 24th.*